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the judicially created ..... of copending Application No 11/149,808 in view of Ohkawa (USPN 4891399”.

Ohkawa teaches that zinc oxide is a filler that can be compounded into a thermoplastic resin to enhance its mechanical properties ( 1:31-39). The Applicant asserts that the use of zinc oxide in the ‘808 application results in the new discovery that zinc oxide has a synergistic effect when combined with zinc borate and/or calcium borate compounds; this effect enhances their ability to perform as a fungicide and preservative.

Zinc oxide is known to have antifungal characteristics and offers an economic advantage with respect to borate compounds, but by itself is not effective in lignocellulosic composites with either thermosetting or thermoplastic resins.

However Applicant asserts that when combined in the ratios described in the ‘808 application, there is a synergistic effect whereby a given weight % loading of a combined zinc oxide/zinc borate (or calcium borate) mixture is equally effective as the same weight % loading of only zinc borate (or calcium borate) in preventing decay or surface impairment of lignocellulosic composites. This synergism allows a more cost effective method of providing an important preservative capability for lignocellulosic composite products and is an unexpected result of this invention.

#### OA Item 3: Double Patenting

The Office Action states: “Claims 1-4, 6-11, 14-20, 22-27, and 31 are provisionally rejected ..... copending Application No 10/909,053 in view of Nadkarni (USPN

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5514478)". Note: On 9-9-05 Applicant received a separate OA regarding application '053 and is preparing a response to that document – the following information is a subset of that response.

The OA acknowledges that Claim 1 in the '053 application is different because it includes a dust reducing amount of moisture prior to forming the composite. However the Action then concludes that this difference would have been *prima facie* obvious to one of ordinary skill because borates including zinc borate are known to be hydrophilic as taught by Nadkarni (4:44-45).

Nadkarni does not teach that zinc borate is hydrophilic but rather teaches that the addition of zinc borate to a solution of nitrilotrismethylenetriphosphonic acid (NTPA), phosphoric acid, and polyacrylic acid will make that complex solution hydrophilic. Applicant asserts that the two borates in the '053 application, zinc borate and calcium borate, are hydroscopic.

The CRC Handbook of Chemistry and Physics, 86<sup>th</sup> Edition, 2005-2006, p 4-96 states all forms of zinc borate are only slightly soluble in water and the most common commercial form, zinc borate hemiheptahydrate, is insoluble in water. Lloyd (USPN 6368529) confirms zinc borate is of low solubility (1:47-50). The Applicant had zinc borate tested by a Good Lab Practices (GLP) certified laboratory with a result of 0.0032 gm/liter at 20°C, which represents an extremely low solubility material.

Although some alkali borates, such as sodium, potassium, and ammonium borates

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have solubilities ranging from 2.5 to 43 wt. % at 20°C (Kirk-Othmer, *Encyclopedia of Chemical Technology*, 4<sup>th</sup> Edition, p 383), calcium borate is an alkaline borate which have low solubilities. For example, colemanite, a calcium borate, has a solubility of 0.1% at 25°C (Kirk-Othmer, p 403).

The uniqueness of '053 is the development of a low dust powder with good flow properties from hydroscopic borate powders. This provides the major new advantage that significantly (75 to 95%) less dust is generated when a commercial size (several hundred pound) bag of zinc borate or calcium borate is discharged in a manufacturing facility that uses these compounds as a raw material. The alternative low dust approach, as described in Fookes (USPN 5972266), is to disperse the zinc borate powder with the standard moisture content of less than 1% in a mixture containing 25% to 80% water and wax and then spray the dispersed material onto the wood. Thus both the low dust product itself and the process of wood preservation using this low dust product differ significantly from the previous art. A major limitation of the Fookes teaching, the need to disperse the zinc borate powder and then spray it onto the wood, has been eliminated.

The development of a low dust zinc borate and calcium borate powders was not an obvious process. Prior to discovering this invention, experiments were performed by adding 2% and 5% water to the standard zinc borate powder; these experiments resulted in failure. No straightforward spraying or mixing technique could be found that uniformly distributed the water throughout the material at these low moisture contents.

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The resulting powder had clumps of agglomerated particles interspersed with standard powder with the result that flowability was impaired. Further, even if a relatively economical technique could have been discovered, it would require an additional process to produce the low dust zinc borate or calcium borate powder of this current invention.

The invention described in '053 made the discovery that a low dust powder could be economically produced by controlling the final drying step in the standard zinc borate production process. The resulting low dust powder provides both environmental protection and economic advantage; a lower density of particulate matter exists in the workplace and less powder is lost when the zinc borate or calcium borate is incorporated into the wood composite product. Finally the current invention resulted in two unexpected discoveries:

1. The residual moisture resulting from the invention was so uniformly distributed in the material that the flow properties of the low dust borate compound are equivalent to those of the regular compound at moisture levels as high as 10 percent.
2. The uniform moisture distribution is so effective at reducing dust that at a moisture level of only 2%, dusting was reduced over 70%. This discovery allows these low dust compounds to be used with both thermosetting and thermoplastic resins.

In summary, this invention produced the unexpected result that water insoluble zinc

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borate and calcium borate preservatives can be easily produced as low dust powders that can be incorporated into lignocellulosic thermosetting and thermoplastic composites as readily as the more dust prone versions of these compounds produced using prior art.

**OA Item 4: Claim Rejections – 35 USC § 102**

The Office Action states: **Claims 1-5, 14-17, 20, 21, and 31** are rejected under 35 U.S.C. 102(b) as being anticipated by Aida (USPN 5221781). It further states “**As to Claim 1**, Aida teaches a method for forming lignocellulosic thermoplastic composite products comprising incorporating an amount of boron-containing fungicide prior to forming the composite product.” In the 10/21 interview the examiner stated that the amount of borates taught by Aida appeared to be greater than those of claims 2 and 3 and withdrew rejections of claims 2 and 3 pending a new search for these limitations. However in the 11/16 interview the examiner directed attention to Aida 6:62 and 7: 13-15, stating that Aida may be teaching inorganic flame retardants from 5 to 200 parts per 100 parts of resin, which appears to overlap with the boron containing compounds claimed in the present invention.

Applicant has amended claims 1 and 16 (11 after amendments) to include the constraint noted in the specification that the lignocellulosic material is 25 to 75 percent by weight of the total composite. Based on this limitation, which is not found in Aida, Applicant requests that the rejection of claims 1, 2, 3, and 16 (11 after amendments), and 17 (12 after amendments) be withdrawn .

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Aida does not teach a minimum lignocellulosic filler range. Further it does not appear that Aida even teaches the combination of organic fillers with inorganic flame retardants such as zinc borate. Although he has several references combining inorganic fillers with either organic or inorganic flame retardants (including 3:1-5, 7:33-34, 8:22-25, 8:64-68, claim 6, and all 24 examples) there is no mention of combining organic fillers with inorganic flame retardants. Further, by noting that thermoplastic resins have the drawback that they are easy to burn because of organic compounds (1:36-40), Aida suggests that composites with organic fillers would require fire retardant loadings above his stated minimum levels.

Finally, the only specific loading instructions provided by Aida involving the use of borate compounds is the statement that the range when only using inorganic flame retardants is 40 to 200 parts by weight (7:15-20). Aida does not rule out combining organic and inorganic flame retardants, but provides no guidance regarding appropriate ratios when the two are mixed together. Considering this lack of guidance in light of Aida's suggestion that organic fillers would require additional fire retardant loadings increases the uncertainty to a level that indicates Aida does not teach a range when combining an organic filler and an inorganic flame retardant in a thermoplastic composite. At the least, the conclusion would be the loadings would be greater than those in claims 2, 3, and 17.

In summary, Aida does not incorporate the limitations of claims 1 and 16 for two

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reasons: (a) he does not have a minimum lignocellulosic loading requirement and (b) he does not appear to teach combining organic fillers with inorganic flame retardants . Aida does not incorporate the limitations of claims 2, 3, and 17 for three reasons: (a), (b), and (c) the fact his loadings are greater than those contained in the claims. Applicant therefore requests these claims be reinstated.

**Item 5: Claim Rejections – 35 USC § 103**

The OA states “ **Claims 6-13, 18, 19, 22-29** are rejected under 35 U.S.C. 103(a) as being unpatentable over Aida (USPN 5221781) in view of Lloyd (USPN6368529). Applicant requests the withdrawal of this rejection of these claims based on three arguments.

First, as described in item 4 above, Applicant argues that Aida does not anticipate the amended claims and a *prima facie* case for a 103 rejection no longer exists.

Next, Applicant has filed two affidavits describing how the first objective of this present invention covered by claims 6-13 ( 1-10 after amendments) was an unexpected result and met a long felt need.

Finally, applicant asserts there was no motivation to combine Lloyd with Aida. Lloyd teaches three advantages for calcium borate when used in lignocellulosic composites ( 1: 49-60), often called wood composites (WC's) but none of these advantages apply when lignocellulosic thermoplastic composites, often called wood-plastic composites (WPC's) are involved:

- 1.. Lloyd teaches that an advantage of calcium borate used in WC's is the improved

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disposal of scrap material by burning (1: 52-55, 2:16-19 and Example 2). However WPC's, unlike WC's, are based on linear or slightly branched polymers in which the molecular chains flow over each other when heated and solidify into new shapes when cooled. This process of softening with heating and hardening with cooling can be repeated as often as needed without introducing chemical changes, allowing scrap and waste material to be recycled and reclaimed. WPC scrap can be, and is, recycled to reduce manufacturing costs and maintain an environmentally compliant operation.

The Society of the Plastics Industry, Inc. (the major trade association representing the plastics industry) and the Environmental Protection Agency have made recycling of waste or spilled plastic pellets a joint recommendation. This recycling eliminates the need or desirability to burn scrap material and therefore eliminates this as a motivation to use calcium borate in WPC's.

2. Lloyd teaches "An additional advantage of producing composite wood products with the calcium borate additives in place of conventionally used zinc borate is that the calcium borates have much better flow properties, making them easier to store and handle in processing equipment" (9:1-5). However Lloyd then teaches that "Nobelite is preferred for superior flow properties, when compared with zinc borate and the finely ground naturally occurring calcium polytriborates" (10:15-20); significantly limiting any advantage to only one of the nine calcium borates claimed in '059. Lloyd

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then teaches that only the calcium polytriborates (Colemanite 1 & 2) were roughly comparable to zinc borate in tests against both types of fungi after leaching (7: 20-25), thereby describing a situation where the best material for flow properties, Nobelite, is not as effective in doing the primary task – controlling fungal growth. This alone would eliminate the motivation to use calcium borates based on an advantage of better flow properties.

Further, even if all the calcium borates had superior flow properties, this would not be an advantage in WPC manufacturing. As described on Page 13 of *Wood-Plastic Composites in the United States*, WPC's have many additives and these components are pre-mixed before compounding. Also, plastics manufacturing equipment has been designed to handle powders with a varying flowability characteristics; unlike WC processing, WPC manufacturing must accommodate a wide range of additives including UV stabilizers, mold release agents, coupling agents, colorants, and preservatives.

3. Lloyd teaches that “in working with composites containing zinc borate, metal tools, such as saws, grinders and similar cutting tools may suffer significant wear and permanent failure due to the borate’s hardness” (1: 52:55). However there are no studies or evidence provided in the Lloyds IDS forms that would support the statement that this may occur and no comparison is made with respect to calcium borates.

Applicant's review of the information available on tool wear that existed at the time

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of this invention found no study regarding zinc borate wear of tools.

Using Lloyd's statement that the hardness of zinc borate may cause wear to tools, Applicant notes that the preferred calcium borate (Colemanite) is slightly harder measured by the Mohs scale (4.5) than zinc borate (Mohrs = 4.0). Therefore calcium borate would cause no more wear on tools than zinc borate, removing any potential advantage in this arena.

Finally, at the time of the invention a definitive WPC tool wear study was available; a leading institution in tool wear study, the Wood Machining & Tool Research Program at North Carolina State University, published *Wppd Fiber-Plastic Composites: Machining and Surface Quality* in Aug, 2001. Page 1 of the report states: "Wood plastic composite materials wear carbide tools more than solid wood does. Some products wear the tool up to as much as six times as much compared to white pine". It is clear that a small hardness difference, if any, between wear on a WC loaded with 4% zinc borate vs one loaded with 4% calcium borate would be insignificant compared to the difference in tool wear between wood products vs WPC material. Clearly tool wear provides no motivation to use calcium borate.

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**Item 6: Claim Rejections – 35 USC § 103**

The OA states that claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Aida in view of Chow (USPN 5130352). Applicant requests the withdrawal of this rejection of these claims based on two arguments.

First, as described in item 4 above, Applicant argues that Aida does not anticipate the amended claims and a *prima facie* case for a 103 rejection no longer exists.

Then, Applicant asserts that odor suppression taught by Chow is not a motive in the production of WPC decking material that is used in an outdoor environment. This was important in Chow's teaching as closed articles such as containers or indoor articles such as trays are described (5: 5-9); this constraint does not exist in outdoor decking material.

**Conclusion**

For all the reasons given above, Applicant respectfully submits that all corrections to the specification have been made, the claims define over the prior art under Section 102 and have been so modified, and distinctions are of patentable merit under Section 103 because of the numerous reasons outlined in this paper and the accompanying declarations. Applicant also submits the double patenting objections are overcome in this response by the explanation of new discoveries and unexpected results. Accordingly

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Applicant submits this application is now in full condition for allowance.

Respectfully submitted,

  
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